JOINT ACCOBAMS-ASCOBANS WORKSHOP WITH NAVIES ON UNDERWATER NOISE AND CETACEANS

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Content

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Context

ACCOBAMS[1] and ASCOBANS[2] are intergovernmental Agreements established under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals (CMS). Addressing the impacts of anthropogenic noise on cetaceans is considered as a high priority for both Agreements, to reach their shared goal of achieving or maintaining a favourable conservation status for cetaceans.

In 2019, the ACCOBAMS Secretariat organized a workshop with national navies to showcase how the ACCOBAMS Scientific Committee can provide advice and assistance with respect to mitigating adverse effects on cetaceans for any future military exercises. In 2022, the ACCOBAMS Parties expressed their interest in organizing a second workshop to facilitate the exchange of relevant information with the competent authorities before the start of any military exercises.

In 2021, the ASCOBANS Advisory Committee requested the Secretariat to convene a workshop with representatives of national navies and NATO to consider underwater noise issues, such as navies' mitigation protocols for use of military sonars and management of other activities that can contribute to potentially harmful underwater noise, including the removal and/or detonation of Unexploded Ordnance (UXO). In addition, solutions for acoustic monitoring and bycatch mitigation (deterrent devices) in synergy with national security activities specifically in the Baltic needed to be addressed and discussed in relation to the endangered population of harbour porpoise.

Objectives of the workshop were to exchange information on best practice experiences and activities, to promote collaboration, and to discuss steps towards improved exchange of information. Invitees to the workshop were national navies in the ACCOBAMS and ASCOBANS Areas, NATO, and a limited number of experts from the Joint Noise Working Group (JNWG) of CMS, ACCOBAMS and ASCOBANS, the ACCOBAMS Scientific Committee, ASCOBANS Advisory Committee, and the ASCOBANS Jastarnia and North Sea Groups. The full list of participants appears in Annex I.

This report documents the outcomes of the workshop, providing an overview of the discussions, key findings, and recommendations that serve as a roadmap for future collaboration.

1. Welcome

The workshop commenced with a warm welcome by Vice-Admiral Christophe Lucas, Commander-in-Chief for the Mediterranean Maritime Prefecture, who highlighted the need to reconcile naval operational requirements with the preservation of marine biodiversity. He emphasized the importance of proactive measures to address underwater noise, stressing that collaboration among navies, scientists, and environmental organizations is key to achieving sustainable solutions.

Following the welcome, Maÿlis Salivas, ACCOBAMS Programme Officer, and Jenny Renell, ASCOBANS Coordinator, provided overviews of their Agreements. Ms Salivas noted that ACCOBAMS was established in 1996 and has 24 Parties. The objectives include promoting regional collaboration, conducting scientific research, and implementing conservation measures to reduce threats to cetaceans. She emphasized that one of the most urgent and complex challenges that cetaceans face today is the impact of anthropogenic underwater noise—an issue that brought everyone together for the workshop. Ms Renell explained that ASCOBANS is a United Nations treaty established in 1992, and administered by the United Nations Environment Programme. It has ten Parties and seven non-Party Range States. The Agreement covers all

[1] Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area
[2] Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas

small, toothed whales occurring in the area. She highlighted that since migratory cetaceans regularly cross national borders, their protection can only effectively be achieved by means of international cooperation.

Captain Frédéric Sanoner and Professor Peter G.H. Evans, facilitators of the workshop, then outlined what they wanted the workshop to achieve, and how the workshop could reach success. They encouraged open dialogue and knowledge-sharing as central themes of the workshop. They introduced the agenda (Annex II), emphasizing the need for practical and actionable outcomes. Prof. Evans outlined the scientific context, noting that marine mammals depend particularly on sound that propagates at least four times faster through water than in air, highlighting the serious consequences of noise pollution on cetacean behaviour and physiology. He stressed the importance of international collaboration to address this issue effectively. Their remarks framed the workshop as a platform to advance scientific understanding and foster cross-sectoral collaboration.

2. Introduction: Underwater noise

Florian Expert, representing the French Ministry of Environment, presented France's commitment to reducing the impacts of underwater noise. He outlined national initiatives and international collaborations aimed at mitigating noise pollution and highlighted the importance of hosting this workshop as a demonstration of France's dedication to marine conservation.

The French national effort on underwater noise monitored by the Water and Biodiversity Directorate (Direction de l'eau et de la biodiversité, DEB) is largely based on the Marine Strategy Framework Directive (MSFD), which requires EU Member States to each define a marine strategy aimed at reducing the pressures exerted by human activities on the marine environment to levels compatible with achieving or maintaining good environmental status (GES) of the marine waters under their jurisdiction. This project is therefore based on environmental objectives limiting and reducing the pressures required to achieve or maintain good environmental status; defining and assessing the good ecological status of marine waters; and the pressures affecting them, through a monitoring programme.

The French national multidisciplinary group on underwater noise, co-led by the Directorate General for Maritime Affairs, Fisheries and Aquaculture (la direction générale des affaires maritimes, de la pêche et de l'aquaculture, DGAMPA) and DEB, is made up of entities and representatives with a variety of specialities (biology, acoustics, naval industry, etc.) and different vocations (research, management, mediation, etc.). It has held a dedicated annual seminar since it was set up in 2020, and in 2023 contributed in particular to renewing the dialogue between the Directorate for Water and Biodiversity and the French Navy. Mr Expert noted that this dialogue is necessary and beneficial, and hoped that it will continue to ensure optimal management of maritime activities This must reconcile the need for military exercises, which respond to geopolitical issues of the utmost importance, and the protection of marine species, the latter being a daily concern for both the Directorate for Water and Biodiversity and the Navy.

Fabrizio Borsani, co-chair of the EU Technical Group on Underwater Noise (TG Noise), provided an overview of the group's objectives and activities. He explained the role of TG Noise in facilitating cooperation among EU Member States to develop strategies for monitoring and mitigating underwater noise. His presentation underscored the importance of aligning national and regional approaches to achieve effective noise management.

TG Noise oversees technical work on issues related to pollution from underwater noise. The aim of the work is to advise EU Member States on the operational implementation of descriptor 11 under the Marine Strategy Framework Directive (MSFD), dedicated to underwater noise. The group has a lot of IGO observers, including ACCOBAMS. As of today, TG Noise is co-chaired by Sweden, France and Italy. It meets 1-2 times a year and is organized in subgroups granting regional representativity to accomplished tasks inherent to the mandate.

Options for threshold values for impulsive noise (D11C1) as well as for continuous noise (D11C2) were recently adopted (OJ C, 11.03.2024); they are officially defined as:

> D11C1 impulsive noise: For short-term exposure (1 day, i.e., daily exposure), the maximum proportion of an assessment/habitat area utilized by a species of interest that is accepted to be exposed to impulsive noise levels higher than the Level of Onset of Biologically adverse Effects (LOBE), over 1 day, is 20 % or lower (≤ 20 %). For long-term exposure (1 year), the average exposure is calculated. The maximum proportion of an assessment/habitat area utilised by a species of interest that is accepted to be exposed to impulsive noise levels higher than LOBE, over 1 year on average, is 10 % or lower (≤ 10 %).
>
> D11C2 continuous noise: 20 % of the target species' habitat having noise levels above LOBE not to be exceeded in any month of the assessment year, in agreement with the conservation objective of the 80 % of the carrying capacity/habitat size.

The latest guidance from TG Noise includes Options for Threshold values on impulsive sound (2023) and continuous sound (2023), and upcoming Update Monitoring Guidance UW Noise (due 2025).

This introductory session established the context for the workshop, setting the stage for the subsequent plenary discussions and fostering a shared sense of responsibility among participants.

3. Presentations and plenary discussions

Session 1: Use of sonar and impact on cetaceans

Effects of sonar on cetaceans

Prof. Peter Tyack presented 25 years of extensive research on the impact of sonar on cetaceans, focusing particularly on beaked whales. He detailed a series of behavioural and physiological responses to sonar exposure, including avoidance, altered dive patterns, and, most notably, mass strandings. His presentation traced the origins of these discoveries, beginning with a mass stranding in Greece, and highlighted subsequent research that revealed physiological impacts such as embolisms triggered by panic induced gas management issues.

The "zones of influence" model of effect of sound assumes that injury is caused by intense sounds at close range. Studies on physiological effects of noise on hearing confirm that relatively large doses of sound energy are required to reduce hearing sensitivity. However, in 1998 a Nature paper described an unusual case of 13 beaked whales stranding during a naval sonar exercise. By 2005, researchers identified a dozen cases of >10 beaked whales stranding during naval exercises involving mid-frequency sonars. Prof. Tyack reviewed a series of studies that demonstrate that unusually low received levels of sonar disrupt echolocation-based foraging dives of beaked whales at ranges up to 100 km. Similar analyses show harbour porpoise are also very sensitive – they avoid sounds of piling at ranges of 30 km. The sensitivity of animals to sound can be captured in dose-response functions that relate acoustic exposure to behavioural or physiological responses. Advanced statistical methods make it possible to estimate these functions with low sample sizes, to estimate effects of behavioural context, and to use observed sensitivity to decide which species need to be treated separately and which can be treated as a group.

Discussion

Regarding the management of multiple stressors, Prof. Tyack emphasized the importance of identifying key stressors that can be effectively mitigated and explained the need for integrated management approaches.

Concerns were raised about the physiological responses to sonar-induced stress, such as fat embolism. Prof. Tyack elaborated that while behavioural responses often dominate discussions, physiological impacts such

as gas emboli are a significant area of concern and must be factored into risk assessments. Cumulative impacts were also a factor – we need to see what stressors *can* be reduced such as underwater noise and fishing bycatch.

In addition to beaked whales, minke whales were identified as highly sensitive to sonar. Sperm whales and pilot whales, though seemingly less reactive, exhibit more subtle responses that may be more difficult to detect but could still have ecological consequences.

Use of Sonar and impacts on cetaceans

Dr Odile Gérard (Ministry of Defence) presented research conducted and/or sponsored by the French Defence Procurement Agency (Direction générale de l'armement - DGA) in collaboration with other Naval and military institutions the 3S (Sea-mammal Sonar Safety) international consortium. A short introduction on sonar was presented, emphasizing the role of environmental conditions in shaping acoustic propagation patterns: in particular the influence of sound frequencies and temperature profiles.

She illustrated the effects of sonar on marine mammals through the 3S consortium (partly sponsored by DGA). The consortium uses multi-sensor tags to study the behaviour of the animals before, during and after sonar exposure. Six species and different scenarios were studied. But the emphasis was placed on northern bottlenose whale results, a beaked whale species studied by 3S. During the experiments, the tagged whales exhibited behaviours that have typically been documented for beaked whales, during exposure to naval ASW sonar including leaving the area, cessation of clicking and feeding, even at low levels of reception. Of the six species studied (killer, sperm, pilot, bottlenose, minke, and humpback whales), bottlenose whales and minkes responded at the lowest received levels with the most severe responses. Lastly, to mitigate the risk, Dr Gérard noted habitat modeling to help with decision-making before planning an exercise. The results of Observatoire Pelagis were shown in the North Atlantic and Mediterranean Sea for deep divers (beaked whales and sperm whales) using visual observations. For sperm whales the ACCOBAMS Survey Initiative campaign allowed the development of habitat modeling in Mediterranean Sea using acoustic observations.

Discussion

It was noted that there is a need for more collaborative monitoring of beaked whales between stakeholders and nations, to be able to better predict where the whales are and what times/areas should be avoided. One of the monitoring methods could be marine gliders equipped with acoustic sensors to improve detection of beaked whales. Prof. Tyack reiterated the sensitivity of species such as minke whales and porpoises, emphasizing that the apparent lack of responses in some species, such as sperm whales and pilot whales, might reflect detection challenges rather than true insensitivity.

A comment was raised about pre-operation monitoring and that it would be a good idea from the cetacean conservation point of view. However, it was noted it may be challenging to do in practice for various reasons.

Session Summary: Prof Tyack's presentation underscored the complex relationship between sonar emissions and cetacean responses, particularly emphasizing the need to balance naval operational requirements with species-specific mitigation measures. Discussions highlighted the need for further research into both behavioural and physiological impacts, as well as the importance of identifying safe areas to mitigate risks. Dr Gerard's presentation highlighted advances in sonar propagation studies and technologies aimed at improving the detection of sensitive species. Discussions centered on the application of these findings to naval operations, with an emphasis on collaboration between scientific and military institutions to enhance risk mitigation strategies.

Session 2: Current mitigation procedures implemented by Navies

Measures to Mitigate the Effects of Sonar on Marine Mammals

Prof. Peter Tyack opened the session with a presentation on risk assessment strategies and mitigation techniques. He emphasized the role of real-time visual and acoustic monitoring to detect cetaceans during naval exercises. Prof. Tyack highlighted how functional zones could be identified for beaked whales using arrays of hydrophones that detect both buzzes and "normal clicking." He also addressed the risks of mass strandings, referencing historical incidents in Northern Europe where large-scale events demonstrated the severe consequences of insufficient safeguards. Prof. Tyack further elaborated on the importance of post-operational monitoring, including detailed reporting and contributing to noise registers for better management of naval activities.

Measures to mitigate the effects of sonar on marine mammals vary across nations, but most NATO Navies have several stages for sonar risk assessment:

- Long-term pre-operation planning for sonar use prior to operation: Sonar Risk Assessments
- Operation-specific shore planning: selection of site and dates; source level and duration of transmission
- During operation:
    - Measures just before sonar use: monitoring, go/no-go decision aids
    - Measures at start of sonar use: ramp-up
    - Monitoring for animals during sonar operation with shut-down if in mitigation action zone
- Post-operation: incident reporting

Sonar risk assessment requires assessing important habitats and the distribution of vulnerable/sensitive species in time and space, considering how elements of the exercise such as source level, duty cycle, and time, place and duration of the exercise will impact risk, using propagation models and environmental data to estimate how sound will travel. A critical tool for estimating the impact of sonar operations on marine mammals is the function relating acoustic dosage to behavioural or physiological responses. Some risk assessments use a single threshold for impact, but there is enough variability within a population in the noise level required to elicit a response that using the full dose-response function is essential for an accurate estimate of the number of animals affected. Proposed measures for reducing exposure of animals involve slowly ramping up sonar intensity or increasing the duty cycle to reduce the sound pressure level (SPL). Studies with large whales show that reducing SPL by increasing duty cycle may not reduce impact; ramp up can be effective at reducing exposure for the most sensitive animals but not for durations longer than a few minutes. Most nations use observers on the bridge to monitor for marine mammals within a few kilometres of a ship transmitting sonar, and some nations add passive acoustic monitoring. Studies of the effectiveness of these methods in detecting marine mammals show it can be helpful but is likely to miss most animals entering mitigation action zones that are usually set at ranges of up to 2 km. However, the previous effects of sonar talk reviewed evidence that effects can extend kilometres from the source. Methods that monitor the actual impact areas to assess animal density and use of complete dose-response functions to estimate impact are essential for effective mitigation, especially for sensitive species such as beaked whales and porpoises. Using an array of moored or mobile acoustic monitors will usually be more effective than limiting observations to the ship carrying the sound source. Environment agencies need to monitor cumulative effects of sonar along with other stressors on vulnerable populations. There are enough unknowns that active search for unexpected effects across all protected taxa is important.

Discussion

A question was raised about the guidance provided under EU Descriptor 11 of the MSFD and its relevance for Navies. Mr Borsani emphasized the need for NATO Navies to collaboratively establish areas for exercises

that adhere to a standardized risk assessment methodology. Prof Tyack acknowledged the importance of such frameworks and suggested that resource pooling could enhance their implementation.

Mr Koschinski questioned the gaps in post-exercise monitoring efforts, citing the summer 2018 cetacean mass mortality event in the eastern North Atlantic as an example. He wondered whether the lack of detected events could be due to insufficient monitoring or a perceived lack of priority. Concerns were also raised about the low visibility of stranded animals compared to those that might have died but were not accounted for. Prof Tyack supported the suggestion of integrating drift analysis to estimate unseen mortality rates, and emphasized the importance of enhancing post-monitoring frameworks.

Following Prof. Tyack's presentation, representatives from various navies shared their approaches to mitigating sonar impacts:

a. France emphasized the use of scientific data to identify mammal presence in exercise areas. Protocols include MMO (Marine Mammal Observer) deployment, halting exercises when animals are sighted, and adhering to a Navy-specific HSE document (EXPLAN). French Navy representatives affirmed that no strandings have occurred in areas south of Toulon due to Naval exercises. Ramp-up procedures, such as emitting a single ping to assess surroundings, are sometimes utilized to reduce impacts in basic training or technical trials.
b. UK described a three-stage process: pre-exercise planning using risk assessment software, real-time monitoring during exercises, and post-exercise evaluations. All marine mammals are treated equally, interactions recorded and reported, and activities are halted upon visual or acoustic detection. Decision-making relies heavily on trained PAM operators and detailed risk assessment processes.
c. Sweden highlighted that mitigation procedures need to be based on a risk assessment including consideration of different factors for each specific situation.
d. Spain detailed their approach, including training personnel, centralizing MMO data at the Oceanographic Centre, and adjusting sonar power levels when possible. Post-exercise checks and coordination with ministries were emphasized.
e. Italy discussed the adoption of a probability-based risk assessment model to predict cetacean presence and guide mitigation measures. Extended ramp-up periods and correlation analyses between environmental conditions and sightings were highlighted.
f. Greece emphasized PAM operator training and navigational warnings.
g. Bulgaria focused on mitigating impacts on porpoises during mine clearance in the Black Sea. No submarines deployed.
h. The Netherlands noted that the ambition was to operate sonar in a responsible manner: monitoring, and risk assessment using SAKAMATA tool. The idea was that the operator doesn't need to have expertise – the tool does it for them.
i. NATO's Research Centre suggested the use of the upcoming guidelines for experimental tactics.

Mitigation of underwater explosions

Mr Sven Koschinski presented on mitigating underwater explosions, such as those caused by World War II mine blasts. Mr Koschinski outlined the severe physiological impacts of shock waves on marine mammals, citing examples of injuries and fatalities among harbour porpoises. He described mitigation measures during planning, at the receiver (e.g., using MMOs and PAM), and at the source (e.g., bubble curtains). In a number of experiments, bubble curtains proved effective in noise reduction and in combination with acoustic deterrent devices have a high ability to prevent physical harm and hearing damage. Koschinski emphasized reducing the number of blasts by further developing recovery and defusing techniques and addressing yet unsolved contamination issues during deflagration.

Navies carry out explosions e.g., in ship shock trials, mine diving, mine hunting and UXO clearance. A resulting shock wave propagates into water and (water saturated) bodies of marine vertebrates such as

cetaceans. Depending on charge size and hydrography this can be deadly for marine mammals at distances of many kilometres. Due to a different hearing physiology and anatomy, cetaceans require larger safety zones than human divers. A post-mortem analysis of harbour porpoises stranded after 42 mine blasts in the marine protected area Fehmarnbelt (Baltic Sea) in 2019 revealed *inter alia* bleeding in acoustic fats of the melon, lower jaw and around the ears as well as fracture or displacement of hearing bones. Rupture of lung tissue or blood vessels result from very strong shear forces in tissues at the gas/water interface. Thus, mitigation is extremely important to avoid injury or death in protected animals. Often, such injuries stay unnoticed due to the absence of specific investigations of freshly stranded animals.

The amount of explosives should be kept to the absolute minimum, and areas and times when vulnerable species occur avoided. Safe-to-handle UXO should be recovered. Environmental impact assessments including modelled shock wave radiation, impact zone and effective radius of acoustic deterrent devices and also considering alternatives should be conducted. Visual and acoustic pre-detonation search and deterrence from the impact area using (multiple) acoustic deterrent devices helps to reduce the number of impacted animals. The use of deterrent devices is specific for each marine mammal species due to differences in hearing ability and behaviour. “Scare” charges do not have a proven effect but they always have a potential for injury.

Among available **noise abatement** procedures greatly reducing the danger zone and thus making operational measures more effective are UXO defusing, deflagration and bubble curtains. For **defusing**, detonation cord with a charge weight of a few 100 grams might be used to separate the gear box with fuse and detonator from the main charge. **Low-order deflagration** can be initiated by a shaped charge. It reduces the peak sound level by >20 dB and due to low detonation velocities does not create a shock wave. However, considerable additional contamination from unburnt residue occurs. A **bubble curtain** is an effective way of reducing the shock wave. In tests, a bubble curtain with a radius of 70 m was shown to reduce the peak pressure by 16 dB and 19 dB when blasting 300 kg mines. With 100 g reference charges a double bubble curtain (with radii between 60 m and 100 m) achieved a reduction of 14 dB peak or 7 dB SEL. The lower noise reduction in SEL results from seismic wave contribution to sound energy.

Discussion

Further discussion and a second tour-de-table followed with some Navies sharing their measures for mitigating the effects of underwater explosions. France, especially, described the use of small explosions (e.g., grenades used as scare charges) approximately one hour before the main blast to encourage marine mammals to leave the area. Also, acoustic cetacean detectors were employed, and explosions halted if cetaceans are detected, noting however that not detecting cetaceans didn’t mean there aren’t any. Safety radii of 300 meters for 1 kg of explosives and 3,000 meters for 1 ton were discussed. French Navy representatives affirmed no stranding events were revealed from their operations. Even if it’s not proven, the effectiveness of the use of “scare” charges is likely.

Other discussion points concerned the recognition of different sensitivities between humans and marine mammals (marine mammals being more vulnerable), the widespread use of PAM equipment to enhance detection capabilities, and suggestions to explore alternative technologies to achieve operational objectives without resorting to large explosions. Overall, the discussions emphasized the importance of international collaboration and data-driven approaches to enhance mitigation measures while balancing operational imperatives and marine conservation efforts.

Session Summary: Prof Tyack presented strategies including real-time and post-operational monitoring, the use of hydrophone arrays to identify functional zones, and highlighting risks such as mass strandings of beaked whales. During discussions, standardized NATO exercise areas were advocated for and the need for enhanced post-monitoring was emphasized. A tour-de-table showcased Naval practices such as the use of MMOs and ramp-up procedures in basic training or technical trials, risk-based planning and

PAM monitoring, with fully instrumented ranges using static acoustics considered a more effective mitigation measure. Mr Koschinski presented on mitigating underwater explosions, stressing bubble curtains and reduced blasting. The session underscored three critical factors navies must consider: the use of sonar, the potential presence of marine mammals, and the threat posed by submarines.

Captain Sanoner highlighted the following key points from a Naval perspective:

- **Risk assessment:** Navies must continuously refine their methods to address emerging challenges and improve mitigation strategies.
- **Legal challenges:** The need to account for legal considerations and societal pressures is increasingly critical.
- **Training alignment:** The principle of "train as we fight" necessitates realistic and operationally aligned exercises, especially given the increasing proximity to conflict areas and risks in European waters.

Session 3: Acoustic monitoring of cetaceans and acoustic deterrent devices

The need for military activities using sonar to detect submarines from hostile nations can pose unanticipated obstacles for cetacean conservation. In the Baltic lives a critically endangered population of harbour porpoise. Its main threat from human activities is fisheries bycatch in static gear and to mitigate this, emergency measures involving the deployment of high-frequency deterrent devices (called pingers) have been recommended by scientists in light of their success elsewhere. However, some concerns have been expressed from navies in the region that this could interfere with their abilities to detect submarines, whilst routine acoustic monitoring of small cetaceans such as porpoises might reveal the naval activities of friendly nations to other less friendly ones.

Prof Jakob Tougaard provided an overview of Passive Acoustic Monitoring (PAM) systems, explaining their applications and the various instruments available, such as PODs (Porpoise Detectors) and full waveform recorders. He highlighted the role of PAM in Environmental Impact Assessments (EIA) and science and discussed the use of seal scarers and other deterrent devices (pingers) during marine construction and naval operations. During the presentation, the potential for dual use of PAM systems to serve both environmental and military objectives was highlighted.

Some concern has been raised recently about possible conflicts between military activities and the use of two key technologies for marine mammal conservation and management of anthropogenic impacts: passive acoustic monitoring devices (PAM) and acoustic deterrent devices (ADD). PAM systems are now very widely available and are indispensable tools for monitoring presence and behaviour of marine mammals, quantifying impact on marine mammals from underwater noise sources and for monitoring long-term trends in anthropogenic noise pollution. These tasks are required by EU directives. PAM systems are, however, also capable of recording underwater sounds from military sources, including sonars and navy vessels. However, these signals are typically very hard to identify in the recordings unless one has information about exactly where and when they occur. The recordings are also of little risk to navies unless the specific details about the source type and position is known as well as the context in which it was used (test, training, actual engagement). As the PAM-based methods cannot be replaced by other methods there is an urgent need to discuss and agree with national Navies under which conditions this monitoring can continue without compromising national security, including possible time and area restrictions.

In contrast to PAM systems, ADDs are not recording, but are placed on static fishing gear and emit acoustic signals to deter porpoises from the net and thereby prevent entanglement and drowning of porpoises. Bycatch is the most significant threat to many cetacean species worldwide. In the Baltic Sea, the current bycatch rate is unsustainably high and EU member states are obliged to act to reduce this bycatch. As for

PAM systems, there is an urgent need to work with national navies to identify signal parameters, including frequency bands, sound levels and ping rates, that will not interfere with navy operations.

Discussion

a. **Pingers and PAM together in mitigation:** Participants debated the relevance and challenges of using pingers and PAM systems in tandem. While pingers may interfere with naval exercises, in some regions, they remain critical tools for fishers to avoid bycatch. The French Navy reported no issues with pingers but emphasized the importance of mapping hydrophone deployments across French waters. This mapping helps determine whether new instruments can be deployed and provides clarity for military operations.

b. **Concerns about pinger range:** Questions arose about the effective range of pingers. Due to classified information, although pinger range itself is well known, this concern could not be fully addressed during the session. However, interactive pingers that activate only in the presence of cetaceans were suggested as a promising alternative.

c. **Data sharing and dual use of PAM equipment:** The potential for PAM systems to serve both environmental and military objectives was discussed. Participants emphasized the need for informal communication channels between scientific and military authorities to enhance trust and cooperation. Encouraging the dual use of PAM equipment was seen as a step forward in balancing conservation goals with operational requirements.

d. **Legal and institutional challenges:** It was noted that legal frameworks, while sometimes perceived as constraints, could serve as opportunities to improve practices. Sven Koschinski cited a case involving a ship shock trial that led to the development of new guidance through collaboration among nature conservation bodies, navies, and governments. The co-facilitator of the workshop from the French Navy echoed this sentiment, emphasizing that internal conflicts are less likely when navy and conservation efforts fall under the same state jurisdiction. The UK Navy highlighted their consistent engagement with nature conservation bodies to align objectives and to prevent conflicts.

Session summary: The session concluded with several takeaways, emphasizing innovation, collaboration, and data transparency. Interactive pingers that activate only in the presence of cetaceans were highlighted as one promising solution to reduce interference during naval operations. Informal communication between military and scientific communities was deemed essential to advance acoustic mitigation measures and to build mutual trust. Legal frameworks were reframed as opportunities to improve practices, ensuring alignment between conservation and operational objectives. Finally, discussions stressed the importance of balancing operational security with accessible data to enhance conservation efforts. Overall, the session underscored the potential for acoustic technologies to bridge the gap between naval operational requirements and cetacean conservation goals, provided that collaborative frameworks and innovative solutions are actively pursued.

Session 4: Critical Cetacean Habitats

Session 4 delved into the identification and protection of critical cetacean habitats, with presentations focusing on Important Marine Mammal Areas (IMMAs) and Marine Protected Areas (MPAs).

Prof Peter Evans delivered a presentation on cetacean density distributions and the mapping of critical habitat in the ASCOBANS area, which hosts 36 cetacean species, including 15 regular, 11 occasional, and 10 vagrant species. This region accounts for 38% of the world's cetacean species, highlighting its ecological significance. Prof. Evans focused on deep diving species, particularly beaked whales (BW), a group of species historically associated with noise sensitivity due to their particular vulnerability to sonar. Data showed an alarming increase in BW strandings, in northern Europe from 23 cases in the 1990s to 163 cases between

2010-2019, attributed to factors such as species range extension and increased exposure to anthropogenic noise.

Prof Evans presented data from both extensive surveys, such as the North Atlantic Sightings Surveys (NASS), Trans North Atlantic Sightings Surveys (TNASS), and SCANS surveys, and more intensive regional ones. These efforts provided crucial maps and datasets on cetacean sightings and abundance, particularly deep divers like sperm whales, pilot whales, and beaked whales. Additional data from the Irish ObSERVE surveys and acoustic detections in the Celtic Seas further enriched our understanding of cetacean distributions. By combining data from the many different surveys over the last forty years and applying modeling efforts, predictive maps have been produced by several different research groups showing the density and distribution of BWs and other species across the Central and Northeast Atlantic regions.

The presentation underscored the importance of avoidance of protected areas, such as NATURA 2000 sites, although those are restricted to a few species such as bottlenose dolphin and harbour porpoise and whereas they are relevant when dealing with unexploded ordnance, they do not apply to deep diving species such as beaked whales or other sensitive species like minke whales. IMMAs (identified by IUCN), and regions designated under OSPAR and HELCOM conventions tend to be more relevant in the context of sonar. Prof. Evans highlighted areas of overlap between anti-submarine exercise zones and IMMAs, emphasizing the need for clear, updated habitat mapping to mitigate conflicts between conservation efforts and naval activities. Previous mapping efforts have used different datasets and require careful interpretation to fully understand potential biases. Nevertheless, there are some clear conclusions that can be made: in the case of beaked whales, they consistently favour areas of sea at depths of 800-3,000 metres. Although that covers large areas of ocean that coincide with locations that navies favour for anti-submarine exercises, there are some density hotspots consistently highlighted: In the central and eastern North Atlantic, these include the canyons in the southern and southeast parts of the Bay of Biscay, the Porcupine Sea Bight, directly west of the Porcupine Bank northwards into the Rockall Trough, and deep areas south and east of Iceland and Greenland. These have all been well mapped now, and boundaries of the above area hotspots are well defined by depth contours. Survey coverage in winter generally remains poor due largely to weather constraints. Although beaked whale species have been shown to be relatively sedentary over extended time periods, seasonal migration movements have been inferred for some species (for example northern bottlenose whale).

Participants inquired about the timeline for translating scientific data into actionable practices by navies. In the UK, it was estimated that it takes approximately 6-10 months to process data received from DEFRA into risk assessment procedures bearing in mind that analysis of new datasets of offshore areas usually occurs at intervals of several years because large-scale surveys of those areas are infrequent. A centralized process for accessing observation data was recommended, with ACCOBAMS and ASCOBANS positioned as potential facilitators to streamline the integration of data into naval planning. Questions arose about the identification of new cetacean species in the ASCOBANS area, with Prof. Evans clarifying that although there have been some range shifts or extensions, no new species had been recorded within the Agreement Area since the 1980s.

Dr Ayaka Amaha Ozturk presented a comprehensive analysis of cetacean habitats in the ACCOBAMS region, encompassing the Mediterranean Sea, the Black Sea, and contiguous Atlantic Area. The Mediterranean and Black Sea host 11 regularly observed cetacean species, along with three subspecies unique to the Black Sea: the bottlenose dolphin, harbour porpoise, and common dolphin. Dr Ozturk's presentation emphasized the region's rich biodiversity and the challenges in monitoring and protecting these critical habitats.

Key findings were derived from the ACCOBAMS Survey Initiative (ASI), conducted in 2018, involving 20 countries and 30 organizations. The survey covered 1.92 million km^2 of the Mediterranean Sea by aircraft and 1.3 million km^2 by vessel, representing 77% of the region. The ASI provided detailed maps of cetacean distribution and litter presence. While vessel-based surveys detected sperm whales and beaked whales

acoustically, the encounter rates for deep divers were low. The ASI's results were compared with previous modeling efforts, highlighting both advances and gaps in the data.

Dr Ozturk also presented the 2019 survey of the Black Sea, which involved five countries and nine organizations. Despite challenges, such as the inability to survey the Azov Sea and parts of the central Black Sea, the survey produced critical insights into the distribution and density of common dolphins, bottlenose dolphins, and harbour porpoises. The results identified hotspots of cetacean presence and emphasized the need for continued research in this complex region.

The presentation covered existing important areas in the ACCOBAMS Area, including IMMAs (IUCN): Areas identified based on scientific evidence; Cetacean Co-occurrence and Human activities (CCHs): Identified by ACCOBAMS, combining cetacean occurrence data with identified threats; EBSAs (Ecologically and Biologically Sensitive Areas): Areas recognized under the Convention on Biological Diversity (CBD); and Particularly Sensitive Sea Areas (PSSAs): Established by the International Maritime Organization (IMO). One PSSA exists in the Northwestern Mediterranean.

Dr Ozturk also highlighted events like the February 2023 mass stranding in Cyprus, linked to naval exercises based on NAVTEX data, and the 2022 mass mortality of Black Sea dolphins, particularly in Ukraine and neighbouring countries.

Participants noted the low detection rates for beaked whales in acoustic surveys, possibly due to the low duty cycle of click production and limited range over which clicks can be detected. Recommendations included integrating Black Sea cetacean diversity data into Bulgarian naval mine-clearance activities and leveraging stranded animal studies to improve understanding of cetacean mortality. NATO representatives expressed interest in supporting data aggregation and facilitating the transformation of policy into military practice. Participants stressed the need for precise, regularly updated coordinates for planning naval exercises. Collaboration proposals included using the Pelagos Sanctuary and the PSSA in the Northwestern Mediterranean as test areas for data integration and for military-conservation partnerships.

Key challenges and discussion points made included data quality and availability, with most surveys limited to summer months and the need for precise and regularly updated habitat maps to support naval planning. Also, centralized processes for accessing observation data, with roles for ACCOBAMS and ASCOBANS to facilitate collaboration, were pointed out. The Hellenic Navy representative noted that the areas presented (IMMAs, CCHs, PSSAs, MPAs, etc.) should not be amalgamated into one map due to the different nature of each area. Finally, participants discussed the difficulty in translating scientific findings into actionable military practices, highlighting the importance of providing officially recognized maps.

Captain Frédéric Sanoner concluded the discussion session emphasizing the importance of leveraging scientific research and international collaboration to protect critical cetacean habitats while balancing naval operational needs. Captain Sanoner also highlighted that large numbers of distribution and habitat maps exist, but navies needed to rely on robust and centralized sources such as through national hydrographic services, with ACCOBAMS and ASCOBANS being a facilitator.

Session summary: Information on species density distributions and how these vary over time was considered critical for mitigating the impacts of military activities. Avoidance of such areas during sonar activities was viewed as the most effective way to safeguard cetaceans. Although the focus has been upon sonar and their potential impacts upon deep diving species, notably beaked whales but including also other species such as pilot whales and sperm whales, if those activities occur in shelf seas, other cetacean species such as minke whale and harbour porpoise may be affected. Maps of those species are therefore also important to consult. In most cases, those are now readily available and provide information on changes in distribution over time. There is a need for researchers to analyse new data on a regular basis and provide those to bodies that can convey the most recent maps to national navies, such as their respective hydrographic services.

4. Recommendations

Following a review of the recommendations established in the 2019 workshop and the progress achieved in implementing those so far, the 2024 workshop participants elaborated the following recommendations[3]:

TITLE	RECOMMENDATION	ACTORS
CENTRALIZED PROCESS FOR DATA ACCESS	Establish a unified process for accessing observation data, with ACCOBAMS and ASCOBANS acting as focal points, and national hydrographic services as data aggregators from scientists. Collaborate with environmental agencies to provide recognized mapping, including officially verified coordinates.	ACCOBAMS, ASCOBANS, National hydrographic services
GUIDELINES FOR DESIGNATED AREAS	Develop clear and specific guidelines for managing activities in designated areas, such as, MPAs[4] and PSSAs[5], ensuring they are practical and adequate to the scope of the designated area.	Navies, National Environmental Agencies
STRENGTHENING LINKS BETWEEN NAVIES AND FOCAL POINTS	Establish internal processes to create robust connections between navies and national environmental Focal Points, reported to ACCOBAMS and ASCOBANS.	Each Country's Navy and Environmental Focal Points
PRE- AND POST-OPERATION MONITORING	Consider implementing pre- and post-operation monitoring, as far as practicable within operational constraints, to evaluate the presence of sensitive species before exercises and assess impacts afterward, incorporating new technologies.	Navies
CONTRIBUTIONS TO NOISE REGISTERS	Consider providing data, as far as practicable within operational constraints, on past naval exercises to international noise registers, such as ICES and ACCOBAMS Noise Registers, to improve transparency and conservation support.	Navies
DISSEMINATION OF BEST PRACTICES	Disseminate information on best environmental practices for managing sonar use and underwater explosions to harmonize efforts across countries and navies.	ACCOBAMS, ASCOBANS
TRAINING TOOLS FOR NAVIES	Provide comprehensive training tools focusing on marine mammal distribution, ecology, and environmental risks to enhance awareness and integration of conservation goals. Explore the possibility of instrumented mobile ranges, with the equipment potentially shared by European nations.	ACCOBAMS, ASCOBANS Navies
COMPREHENSIVE RISK ASSESSMENT	Consider implementing integrated risk assessments balancing environmental risks with operational benefits, including considerations for sonar use and underwater explosions.	Navies

[3] As there was no sufficient time to discuss the recommendations in depth during the workshop, they were finalized by the workshop participants through e-mail correspondence.
[4] Marine Protected Areas.
[5] Particularly Sensitive Sea Areas.

5. Next steps

Workshop participants agreed to reconvene in two years. The representative from the Bulgarian Naval Academy offered to host the next workshop at the Nikola Vaptsarov Naval Academy around October 2026 (dates to be confirmed).

It was also agreed that an informal discussion group would be established, to keep the momentum going and to continue the discussions. The Secretariats would follow up on the group membership via their respective country focal points, as suggested, and encourage the workshop participants to join the group.

6. Close of the Workshop

The workshop demonstrated that balancing naval exercise requirements with cetacean conservation is both achievable and essential. By aligning scientific research, military practices, and environmental policies, the outcomes of this workshop provide a basis for future collaborations aimed at protecting marine biodiversity while ensuring national and global security.

It was noted that the workshop was a good forum to get up-to-date info, and that perhaps ACCOBAMS and ASCOBANS can help give up-to-date info to Navies in the future.

After the customary expressions of thanks, Ms Renell and Ms Salivas concluded the Workshop at 14:40 CET on 27 November 2024. Captain Sanoner invited all participants to join the visit to the Naval Ship ‘FS Mistral’ at the kind invitation of the French Navy.

Annex 1: Workshop Agenda

Tuesday 26 November 2024, at the Résidence du Préfet maritime

Time	Agenda Item	Document / Expected Outcome
09:00	*Registration*	
09:15	**1. Welcome** - Préfet Maritime de la Méditerranée - Adm. Christophe Lucas - ACCOBAMS – Ms. Maÿlis Salivas - ASCOBANS – Ms. Jenny Renell - Introduction by the workshop co-facilitators, Captain Frédéric Sanoner and Prof. Peter G.H. Evans - Tour de table	
09:45	**2. Introduction: Underwater noise** - Presentation by Mr. Florian Expert, MTECT/DEB, France - Presentation by Mr. Junio Fabrizio Borsani, EU TG Noise	
10:15	**3. Use of sonar and impact on cetaceans** *Facilitator: Prof. Peter G.H. Evans* - Presentation by Prof. Peter Tyack, University of St Andrews / Joint Noise Working Group (JNWG) of CMS, ACCOBAMS and ASCOBANS	Inf.3a Report of the ASCOBANS WG on Beaked Whales (2024) Inf.3b Recent atypical mass stranding events in the Mediterranean
10:45	Coffee	
11:15	**3. Use of sonar and impact on cetaceans** *(continued)* - Presentation by Dr. Odile Gérard, DGA Naval Systems, France - Discussion - Summary	
11:45	**4. Current mitigation procedures implemented by Navies** *Facilitator: Captain Frédéric Sanoner* - Presentation by Prof. Peter Tyack on sonar mitigation - Tour-de-table by Navies on mitigation of sonar. Discussion on their effectiveness. Sharing best practices. - Summary	Effectiveness of mitigation measures discussed. Best practices /case studies discussed.
12:30	Lunch	
13:30	**4. Current mitigation procedures implemented by Navies** *(continued)* - Presentation by Mr. Sven Koschinski, JNWG, on mitigation of underwater explosions - Tour-de-table by navies on mitigation of underwater explosions. Discussion on their effectiveness. Sharing best practices. - Summary	Effectiveness of mitigation measures discussed. Best practices /case studies discussed.
15:15	Coffee	
15:45	**5. Acoustic monitoring of cetaceans and acoustic deterrent devices** *Facilitator: Prof. Peter G.H. Evans* - Presentation by Prof. Jakob Tougaard, Aarhus University / JNWG	Potential solutions discussed.

Time	Agenda Item	Document / Expected Outcome
	- Discussion on potential solutions for monitoring and bycatch mitigation (if static acoustic devices and pingers cannot be used) in synergy with national security activities. - Summary	
17:00	End of Day 1	

Wednesday 27 November 2024, at Hotel L'Eautel Toulon Centre

Time	Agenda Item	Document / Expected Outcome
09:00	*Recap of Day 1*	
09:30	**6. Critical cetacean habitats, Important Marine Mammal Areas and Marine Protected Areas** *Facilitator: Prof. Peter G.H. Evans* - Presentation by Prof. Peter Evans, ASCOBANS & Ayaka Amaha Ozturk, ACCOBAMS SC, showing maps of these areas, and why they are important - Discussion on practical ways of sharing and updating the maps with Navies, so that mitigation measures can be taken and Naval exercises planned accordingly - Summary	Practical ways of sharing maps discussed.
10:30	Coffee	
11:00	**7. Review of recommendations from 2019 Workshop** *Facilitators: Prof. Peter G.H. Evans & Captain Frédéric Sanoner*	Inf.7 Proceedings of the ACCOBAMS Workshop on Sonars and Cetaceans Interactions (2019)
11:45	**8. Recommendations** *Facilitators: Prof. Peter G.H. Evans & Captain Frédéric Sanoner* - Agree on a set of recommendations as a concrete outcome of the workshop, particularly regarding collaboration among relevant stakeholders	Recommendations agreed.
12:30	Lunch	
13:30	**9. Next steps** *Facilitators: Prof. Peter G.H. Evans & Captain Frédéric Sanoner* - Consider establishing a small discussion group (for example Navies, scientists, JNWG representatives) to develop a concrete action plan and monitor its implementation. - Agree on the timing of the next joint workshop with Navies. - Consider establishing points of contact / focal points in the Navies.	Venue and dates set for the next workshop. Potential intersessional work outlined.
14:30	**10. Close of the Workshop**	
	Visit to a French Naval Ship, organized by the Préfecture maritime de la Méditerranée	

Annex 2: List of participants

Family name	First name	Organisation	Country
ALBERT	Maxime	French Navy	France
AMAHA OZTURK	Ayaka	ACCOBAMS Scientific Committee	Türkiye
BLANCO	Alvaro	Armada Española	Spain
BLANKETT	Penina	Ministry of the Environment	Finland
BORSANI	Junio Fabrizio	ISPRA & EU TG Noise	Italy
DEMARTE	Maurizio	Italian Hydrographic Office	Italy
DURON	Noémie	DGAMPA	France
EVANS	Peter	JNWG* & Co-Facilitator of the Workshop	United Kingdom
EXPERT	Florian	MTECT/Direction de l'eau et de la biodiversité	France
GERARD	Odile	DGA Naval Systems	France
GIORLI	Giacomo	NATO STO CMRE	Italy
GROSSET	André	Préfecture maritime de la Méditerranée	France
JONES	Roderick	UK Royal Navy	United Kingdom
KAMM	Pia	Swedish Armed Forces, Naval Staff	Sweden
KOSCHINSKI	Sven	JNWG & Meereszoologie	Germany
MAGLIO	Alessio	JNWG & Report writer	Italy
PANCRAZI	Pierre	French Navy	France
PAULY	Eric	French Navy – CECMED	France
PETROPOULOS	Vasileios	Hellenic Navy Hydrographic Service	Greece
PETTERSSON	Bodil	Swedish Armed Forces / Environmental License Section	Sweden
SANONER	Frédéric	French Navy & Co-Facilitator of the Workshop	France
TOUGAARD	Jakob	Aarhus University & JNWG	Denmark
TSVETKOV	Miroslav	Nikola Vaptsarov Naval Academy / Scientific Department	Bulgaria
TYACK	Peter	University of St Andrews & JNWG	United Kingdom
VAN AKEN	Ingrid	Marine Environment Department Belgium	Belgium
VIGILANTE	Giacomo	Maritime ACO Northwood NATO	United Kingdom
VON BENDA-BECKMANN	Alexander	TNO	Netherlands
WEILGART	Lindy	JNWG & TG Noise & Dalhousie University	Canada
Secretariats			
RENELL	Jenny	ASCOBANS Secretariat	Germany
SALIVAS	Maÿlis	ACCOBAMS Secretariat	Monaco

* JNWG = Joint Noise Working Group of CMS, ACCOBAMS and ASCOBANS

Visiting FS MISTRAL. Photo credit: Marine Nationale.